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Assessment of the 1995 snow crab fishery off eastern Nova Scotia

by

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ABSTRACT

Total 1995 landings for Areas 20-24 (1554 mt) did not change from 1994. Areas 20-23 were stabile or marginally higher; only Area 24 landings were lower. Although 1-yr. temporary licenses (9 in Area 23 and 10 in Area 24) were introduced, and crab price was high, total effort appears unchanged from 1994. There is uncertainty in the total effort estimate because it is dependent upon effort information provided by fishers, and fewer data were available in 1995 than in previous years. Catch rates in 1994 and 1995 have also been influenced by factors such as individual boat quotas, whether or not soft-shelled crab were retained, and a reduced fishing season in Area 21.

There was a substantial reduction in the landing of soft-shelled crab in 1995. In 1994 the percentage of soft-shelled crab in the landed catch ranged from 6-26%; in 1995 the range was 0-8%. The high levels of soft-shelled crab in the traps (40-65%) continues to be a problem and some handling mortality probably results.

How long the current level of landings will continue in Areas 20-24 is unclear. Areas 20-24 are currently fished at high effort levels relative to the 1978-93 period. Although the high percentage of soft-shelled crab in the traps is indicative of high removal rates by the fishery, it is also indicative of continuing recruitment. Pre-recruit crab were also more abundant in traps in 1995 than in 1994.

The prospects for snow crab fisheries outside of the current commercial grounds was examined. The occurrence of snow crab in groundfish surveys indicates the snow crab fishery is exploiting most of the areas where snow crab are abundant on the eastern Scotian Shelf. An exploratory fishery for snow crab in NAFO Division 4X had low mean catch rates (1.5 kg/trap) relative to Areas 20-24. The snow crab aggregations in 4X are likely ephemeral but may support a small number of licenses with high trap limits during periods of good recruitment and high price.

Résumé

Les débarquements totaux de 1995 en provenance des zones 20 à 24 (1554 tonnes) sont pratiquement les mêmes que ceux de 1994. Ceux des zones 20 à 23 sont stables ou légèrement supérieurs tandis que ceux de la zone 24 sont inférieurs. L'effort de pêche total semble être le même qu'en 1994, cela en dépit de l'attribution de permis temporaires d'un an (9 pour la zone 23 et 10 pour la zone 24) et d'un prix élevé pour le crabe. La valeur estimée de l'effort total est cependant incertaine car elle dépend des renseignements fournis par les pêcheurs et la quantité de données obtenue pour 1995 est inférieure à celle obtenue pour les années précédentes. Les taux de capture de 1994 et 1995 ont aussi été modifiés par certains facteurs, tels les quotas individuels par bateau, le fait que les crabes à carapace molle ont été conservés ou non et la réduction de la saison de pêche dans la zone 21.

Il y a eu une baisse appréciable des débarquements de crabes à carapace molle en 1995. En 1994, le pourcentage de ces crabes dans les débarquements oscillait entre 6 et 26 %. En 1995, cette gamme était de 0 à 8 %. Le taux élevé de crabes à carapace molle dans les casiers (40-65 %) continue de poser problème et cela est sans doute cause d'une certaine mortalité de manutention.

Nous ne savons pas dans quelle mesure le volume des débarquements en provenance des zones 20 à 24 pourra être maintenu. L'effort de pêche exercé dans les zones 20 à 24 est élevé comparativement à celui noté au cours de la période 1978-1993. La présence d'un pourcentage élevé de crabes à carapace molle dans les casiers est un indice de taux de récolte élevé, mais aussi du maintien du recrutement. Les crabes de stade de pré-recrutement étaient plus abondants dans les casiers en 1995, par rapport à 1994.

La possibilité d'une pêche du crabe des neiges à l'extérieur des fonds commerciaux actuels a aussi été examinée. La présence de crabes des neiges dans les prises des relevés du poisson de fond montre que la pêche du crabe des neiges exploite la plus grande partie des fonds où ce crabe est abondant sur le plateau Scotian. Une pêche exploratoire du crabe des neiges dans la division 4X de l'OPANO a donné de faibles taux de capture (1,5 kg/casier) comparativement à ceux des zones 20 à 24. Les concentrations de crabes des neiges de 4X sont sans doute éphémères, mais pourraient néanmoins suffire à une pêche limitée à un petit nombre de permis à limites de casiers élevées effectuée pendant les périodes de bon recrutement et de prix élevés.

INTRODUCTION

The fishery for snow crab off the east coast of Cape Breton Island (Areas 20 to 24 on Fig. 1) began in the late 1970s. Landings rose rapidly to a peak in 1979; landings and catch rate then dropped precipitously. By 1985 the fishery was deemed to be on the verge of commercial extinction (Elner and Robichaud 1985). Eastern Cape Breton snow crab stocks were thought to be unproductive due to marginal snow crab habitat and little endemic recruitment (Elner and Bailey 1986). In 1986 a pulse of pre-recruits entered commercial catches of snow crab in all areas off eastern Cape Breton (Elner and Robichaud 1987). Total landings for Areas 20-24 rose sharply from 1989 to 1993 when peak levels were reached (2016 mt). Total landings in 1994 declined by 23% over 1993.

Analyses of catch rate, spatial distribution of effort, biomass, and population structure for the period 1978-93 (Tremblay et al. 1994) indicate that the increased landings after 1986 resulted from 3 factors: (i) increased abundance and biomass; (ii) expanded fishing area; (iii) increased total effort. Fishing effort appears to have been driven mainly by catch rate, although snow crab price was a factor in some years. Estimated exploitation rates were highly variable, but averaged about 50% for Areas 23 and 24. For Areas 20-22, mean exploitation was higher and stock performance lower than in Areas 23 and 24. Landings in Areas 20-22 have not reached the 1979 levels, and catch rates were never as high as in Areas 23 and 24.

Management of these fisheries was based strictly on effort controls (seasons[1], limited entry and 30 traps/license) from 1982-93 because of the difficulty in setting quotas where recruitment is unpredictable. License number remained stable except for Area 24 where a total of 7 new licenses were added between 1989 and 1991. These are all restricted to a midshore area that was fished little prior to 1989. In 1994 an output control in the form of a cap on landings (individual boat quota of 65,000 lb or 29.5 mt) was put in effect in Area 23 in response to an industry request to limit high landings.

The incidence of soft-shelled crab in the catch was high in 1994 (up to 50% of the trap catch by number, and up to 26% of the landed catch), and associated with near record high effort (Tremblay and Eagles 1995). For these reasons no increase in effort (i.e. the number of potential trap hauls per day) was recommended for any of Areas 20-24 in 1995. Methods for reducing resource waste due to landing of soft-shelled crab were discussed. A review of the Area 23 experience with individual boat quotas, and associated dock-side monitoring, indicated no apparent effect on the distribution of fishing effort in Area 23 in 1994.

In 1995 there were substantial changes to the management of the snow crab fishery in Areas 20-24. Temporary (1 year) licenses were allowed in Areas 23 (9 licenses) and 24 (10 licenses). These one year licenses were permitted to land 10,000 lb with 10 traps per license. To control total effort, managers introduced individual boat quotas (IBQ) for regular licenses in all Areas. The IBQs were 55,000 lb in Areas 23 and 24, 20,000 lb. in Area 20, 10,000 lb. in Area 21, and 35,000 lb in Area 22 (to a maximum of 350 mt for the Area). All quotas were arrived at by a combination of landings history and negotiations with fishers, and were regulated by dock side monitoring (DSM). An additional management change was directed at reducing the landing of soft-shelled crab. The percentage of soft-shelled crab (as defined by a durometer) in the landed catch of any individual on any given day was not to exceed 10%.

In addition to the fishery on the "traditional" grounds off eastern Cape Breton, there is interest by non-license holders in exploring for snow crab further to the southwest, and further offshore. In NAFO Division 4X, four vessels fished a total of about 130 days between September 1994 and October 1995.

Here we assess the 1995 snow crab fishery in Areas 20-24 and evaluate the effect of the individual boat quotas in Areas 20-24 on total effort, and the soft-shelled crab problem in 1995. We then examine the prospects for snow crab fisheries outside of the current commercial grounds.

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[1] July 22-Sept 15 (Areas 20-23); Aug. 1 - Sept. 20 (Area 24)

MATERIALS AND METHODS

Landings, catch rate and effort, and price for Areas 20-24

Landings - Landings for Areas 20-24 were obtained from dock-side monitoring (DSM) sheets, tabulated by Commercial Data Division, DFO. This represents a change from previous years when landings were obtained from a combination of sales slips and voluntary fishing logs. Note that landings figures for 1995 may change pending final verification by Commercial Data Division.

Catch rate (CPUE) and effort data - The method of obtaining these data has changed over the last 2 years. Voluntary fishing logs were completed in each of Areas 20-24 from 1978-93. Log sheet returns as a percentage of all active fishers ranged from 35% (1981) to 100% (1978 and 1985). On average 75% of the active fishers provided logs that included daily effort (number of traps fished) and landed catch (Tremblay et al. 1994). With the introduction of DSM in Area 23 in 1994, there were fewer effort data received. Although asked to provide these data on DSM sheets, fishers were reluctant to comply. In 1995, science logs were distributed to all fishers, but the return rate to date has been low (less than 25%). A few fishers provided effort information on DSM sheets. As a result our information on daily effort and fishing location is not as good as prior to 1994.

Inshore and Offshore Areas - Because our data on fishing location is not as comprehensive as in the past, it is difficult to develop statistics for sub-areas. In previous assessments statistics were estimated separately for inshore and offshore areas (Tremblay and Eagles 1994). An offshore area in Area 22 ("the crab hole") was treated separately because of its distance from the contiguous inshore portions of Areas 20-22. Offshore grounds (beyond 20 miles to as far as 80 miles from shore) were also recognised for Areas 23 and 24 because they were fished intensively only since the late 1980s (Tremblay et al. 1994). The apportioning of landings to inshore or offshore grounds is dependent upon good location information from fishing logs, or knowledge that an individual's fishing grounds remained constant between years. For 1995 these requirements were not met, and landings are not estimated separately for inshore and offshore portions.

Treatment of catch rate data - For those logs that were returned, we calculated both unstandardised CPUE (total landings divided by total trap number regardless of trap type) and standardised CPUE: that of the most common trap for the Area. To estimate total effort for each Area we divide the total annual landings for the given Area by the catch rate of the most common trap type (Tremblay et al. 1994). There is some potential for bias in the estimates of 1995 catch rate (and thus total effort) because there were fewer fishers who provided effort information. To evaluate this effect we also calculated catch rate and effort for those fishers who provided information in both 1994 and 1995.

Because of the potential for obtaining misleading results from applying Leslie analysis to the eastern Cape Breton snow crab Areas (Tremblay and Eagles 1994), we take the more conservative approach of using the CPUE data only as an index of abundance as suggested by Miller and Mohn (1993). Even this approach must be used with caution because of annual differences in industry practices (i.e extent to which soft-shelled crab is landed and included in the catch rate), and management changes (quotas).

Samples of the commercial catch

Samples of the commercial catch at sea and at dockside were obtained to evaluate the percentage of soft-shelled crab in the trap catch, and to obtain data on pre-recruit catch rate. At-sea samples were obtained in Areas 21, 23, and 24; port samples were obtained in each of Areas 21-24. Sea samples consisted of measuring carapace width (CW), assessing shell condition, measuring claw height and noting the size and colour of the egg clutch in mature females.

For snow crab shell condition we follow the terminology proposed by CAFSAC (Invertebrates and Marine Plants Subcommittee Report 91/19). The terminology reflects two ways of classifying shells: relative age (stages I to IV) and shell hardness (soft or hard as measured by a durometer).

Term	Stage	Durometer reading	Carapace Condition
New	I	< 68	brightly coloured, iridescent, soft, no epibionts, chelae easily bent
Inter-mediate	II	variable	brightly coloured, somewhat iridescent, may have epibionts, chelae not easily bent
Old	III	≥ 68	dull brown dorsally and yellow-brown ventrally, no iridescence, shell abrasion evident, epibionts
Very old	IV	N/A	carapace very dirty and soft, decay may be evident especially at leg joints
Soft	I-II	< 68	
Hard	II-IV	≥ 68	

We have not used the durometer routinely, but regard new-shelled crabs as synonymous with soft-shelled crab.

Claw morphometry distinguishes snow crab that are still growing from those that are in terminal molt. Small-clawed (SC) crab that are still growing are separated from large-clawed (LC) crab that are in terminal molt by plotting claw height against carapace width. Here we use the cutting line equations given in Elner et al. 1988:

$$Ln(CH) = -2.849661 + 1.288020 * Ln(CW) \quad [Areas\ 23\text{-}24]$$

$$Ln(CH) = -3.135785 + 1.348113 * Ln(CW) \quad [Areas\ 20\text{-}22]$$

where CH is chela height and CW is carapace width.

The catch rate of crab that would molt to legal size in 1996 (but would be soft-shell) was estimated in a manner similar to Tremblay et al. 1995:

$$PR\ CPUE\ (kg/trap\ haul) = (PR\ Wt/Landed\ Wt) \times commercial\ CPUE$$

Where PR Wt is the weight of small-clawed crab between 78 and 94 mm CW in the sea sample(s); Landed Wt is the estimated weight of landed crab (≥ 95 mm CW and hard-shelled in 1995) in the sea sample(s); and commercial CPUE is the CPUE (kg/trap) of the landed catch for the day(s) of the sea sample. Individual weights were estimated using the width-weight regression for soft-shelled crab in Taylor and Warren (1989).

Exploratory fishery in NAFO Division 4X, and distribution of snow crab outside of current grounds

For the exploratory fishery in NAFO Division 4X, landings, effort and bycatch came directly from fishing logs kept by the 4 permit-holders. To examine the distribution of snow crab in 4X and in the extreme offshore of the eastern Scotian Shelf, we accessed the MFD groundfish survey data. Groundfish trawl surveys have been conducted at least once per year on the Scotian Shelf since the 1950s, but snow crab were not enumerated until 1980. The shelf was surveyed several times per year from 1980 to 1994. We used only those surveys that are part of the following series: Spring 1980-84 (n=674); Oct-Nov. 1980-84 (n=736); Nov 1982-83 (n=207); 4VWCod 1986-94 (n=736); Georges Bank 1986-94 (n=852); Summer 1980-94 (n=2596).

RESULTS

Areas 20-22

Landings - Total 1995 landings for Areas 20-22 (428 mt) were 8% higher than 1994 and are well above the mean for 1978-93 (ca 315 mt) (Tables 1 and 2, Fig. 2). Individual Areas differed substantially. Landings in the smallest unit, Area 20, were 52% higher than 1994. Average landings/license (8.8 mt) were just below the IBQ of 9 mt. Landings in Area 21 were 7% lower, with average landings/license (3.1 mt) well below the IBQ of 4.5 mt. Landings in Area 22 were up by 10% and average landings/license (7.7 mt) were well below the IBQ of 15.8 mt. The limited data available on fishing location suggests the increased landings in Area 22 were mainly from the offshore component, rather than the inshore grounds.

Catch rate and effort - Compared to 1994, standardised CPUE was stabile in Area 20, 51% higher in Area 21, and down by 15% in Area 22 (Table 1). This compares to 1994 declines of 33-60% over 1993 (Fig. 2).

Standardised total effort was up by 57% in Area 20 (but this is based on only one fisher), down 38% in Area 21, and almost 30% higher in Area 22.

Other indices of CPUE and effort indicate the changes between 1994 and 1995 were not as large as indicated above. 1995 CPUE of 6 fishers in Area 21 was indistinguishable from 1994; their effort was lower by about 20% (Table 3). The mean last fishing day for Area 21 was only slightly earlier in 1995 than 1993-94 (Table 4). For Area 22, both CPUE and effort showed no change from 1994 to 1995 when estimated from the logs of fishers who provided information over several years (Tables 3,4). These comparisons indicate that if the catch and effort of all fishers was available for estimates of standardised CPUE and standardised total effort, the changes indicated in Table 1 would be more moderate.

In spite of the difficulties in interpreting catch and effort data, major trends and Area differences are evident. Area 20 is variable due to its small size, but effort would presumably have been higher in 1995 without an IBQ. Area 21 fishers supported a low individual quota (10,000 lb), and for several years have stopped fishing earlier than other Areas (Table 4). Thus their effort levels were controlled largely by voluntary limits. The effort of Area 22 fishers was not checked (no license reached the IBQ) and due to the high price for crab, fishers continued landing crab even at relatively low catch rates in the offshore portion of the grounds.

The areal distribution of landings over the last 4 years (Fig. 3) delineates the "inshore" and "offshore" portions of Area 22. In 1995, fishers in the offshore portion of Area 22 appear to have searched more widely.

Samples of the commercial catch - There was a high percentage (38%) of soft-shell snow crab in the traps during the at-sea sample in Area 21 (Table 5). Anecdotal evidence indicates that in Area 22 there was a similar high percentage of soft-shelled crab in the traps. The low percentage of soft-shelled crab in the port samples in Areas 21 and 22 indicates only hard crab were retained by fishers (Table 5).

The width frequency distribution of the at-sea sample (Fig. 4) was similar to the 1994 sample although mean size was slightly lower (105 mm vs 109 mm in 1994). Since small-clawed (SC) crab tend to be soft-shelled, and few soft-shelled crab were retained, there were no SC crab in the Area 21 port sample (Fig. 4). The port sample from Glace Bay, representing the offshore portion of Area 22, had the lowest mean size (108 mm), and the highest percentage of soft-shelled and SC crab (Table 5, Fig. 4).

Examination of trends in the Area 21 at-sea samples since 1988 indicate correspondence among the percentages of soft-shelled and SC crab, and the pre-recruit catch rate (Fig. 5). The percentage of SC crab peaked in 1990-92, dropped in 1993, and has increased the last 2 years. Pre-recruit catch rate followed the same trend except that it was low in 1991. Pairwise correlation among the 3 variables yielded only one significant relationship (Pre-recruit C/E and SC crab, $r^2 = 0.50$, $p = 0.05$, $n = 8$).

Pre-recruit catch rate in Area 21 has no apparent utility for predicting future commercial catch rate in Area 21. Correlations with commercial catch rate lagged 1 and 2 yr. were low and non-significant ($r^2 < .05$).

Area 23

Landings - Landings in 1995 (576 mt) were 16% higher than 1994 and are well above the 1978-93 mean of about 320 mt (Tables 1 and 2, Fig. 6). The average landing per regular license was 24.3 mt, just below the 24.9 mt IBQ. The 9 temporary licenses caught an average of 4.5 mt (equals their IBQ).

Catch rate and effort - Standardised CPUE in 1995 was 52% higher than 1994 (Table 1) and was near peak levels (Fig. 6). Standardised total effort was thus 26% lower than 1994, despite the addition of 9 temporary permits. Comparison of logs kept by the same fishers over several years confirm these trends (Tables 3, 4). 1995 CPUE was 72% higher; number of days fished was 38% lower (Table 3). The average last fishing day was about 2 1/2 weeks earlier than 1994 (Table 4).

Location information (from fishing logs and anecdotal) indicates that fishers did not travel the extreme distances from shore (as far as 90 miles) that they had in previous years (Fig. 3). Compared to 1994, a higher proportion of 1995 landings originated from within 30 miles of shore.

Samples of the commercial catch - The 4 at-sea samples obtained in August and September indicate that soft-shelled crab comprised 50-65% of the crab in the inshore traps, and 20-45% of the crab in the offshore traps

(Table 5). This is marginally higher than 1994, when the percentage soft in the inshore catch ranged from 40-50%. As in 1994 few of the soft-shelled crab were retained---there was a low incidence of these crab in port samples (Table 5).

The width frequency of the at-sea samples (Fig. 7) is shifted to smaller sizes compared to 1994. Mean sizes for inshore samples in Aug. and Sept. 1994 were 106 and 111 mm, compared with 97 and 99 mm in Aug. and Sept. 1995 (Table 5). In at-sea samples there were no SC crab greater than 110 mm CW; in port samples the percentage of SC crab was virtually nil because of the non-retention of soft-shelled crab (Fig. 7).

Trends in the Area 23 at-sea samples since 1986 again indicate a correspondence between pre-recruit catch rate and the percentage of soft-shelled and SC crab (Fig. 8). All variables were high in 1988-89, low in 1992-93. The percentage of soft-shell crab and the pre-recruit index rose in 1994 and 1995 but the SC percentage did not. Pairwise correlation among the variables yielded no significant relationships.

To examine whether the pre-recruit catch rate was predictive of future commercial catch rate in Area 23, the 2 variables were correlated with lags in the commercial catch rate of 1-4 years. The results were not intuitive---the relationship was negative at a lag of 1 year ($n=9$, $r^2=0.47$, $p=0.04$) but weak and non-significant for lags of 2, 3 and 4 years.

Area 24

Landings -Total 1995 landings in Area 24 were 17% lower than 1994, due mainly to the imposition of IBQs. Average landings of the 9 active temporary licenses was 4.4 mt, just below the IBQ of 4.5 mt. Landings by the remaining 21 licenses (including those limited to the midshore) averaged 24.3 mt, just below the 24.9 mt IBQ. Compared to 1994 average landings by midshore licenses were down the most (29%) but these licenses had high landings in 1994, partly because soft-shelled crab were retained.

Catch rate and effort - Standardised CPUE was 5% higher for all licenses combined (Table 1). CPUE of midshore licenses was down 12%; CPUE of the regular licenses was 14% higher. Standardised total effort was 23% lower than 1994; both license types showed a decline. Comparison of logs kept by the same fishers over several years confirms these trends. 1995 CPUE was moderately higher; number of days fished was 30% lower (Table 3). The average last fishing day was about 2 weeks earlier than 1994 (Table 4).

The areal distribution of landings over the last 4 years indicates no substantial changes (Fig. 3). There did appear to be some shift to the east in the midshore area in 1995.

Samples of the commercial catch - As in the other Areas, there was a high percentage soft-shelled crab in the traps set in Areas 24. On the inshore grounds the percentage was 56%, on the offshore grounds, 48-54% (Table 5). The low percentage of soft-shelled crab in the port samples indicates most were not retained.

At-sea samples from the inshore portions of Area 24 were distinguished by their low percentage of pre-recruits and high mean size (Fig. 10). The port samples from this area reflect the large sizes---both the 1994 and 1995 port samples had means of 125 mm CW, the highest observed in both years (Table 5; Table 2 in Tremblay et al. 1995). The offshore at-sea sample had a higher proportion of pre-recruits (Fig. 10). Small-clawed crab were less prominent (7% or less) in the Area 24 at-sea samples than in all other samples except that of the offshore portion of Area 23 (Table 5).

Exploratory fishery in 4X

The 4 exploratory permits were allowed 100 traps each. They used a combination of trap types (6' and 7' diameter steel conicals, 4' conicals and a few pyramidal types). Traps of these designs are used in different parts of Areas 20-24 (Tremblay et al. 1994). Total landings between June 1994 and September 1995 were 18.5 mt; most activity was between March and August 1995 (Fig. 11). Mean catch rate was highest in March and April (2-4 kg/trap) but declined thereafter, averaging 1.5 kg/trap for the entire period. Fishing locations were mainly southwest of LaHave Basin, and along the Northeast Channel (Fig. 12).

All fishers reported some bycatch, mainly the stone crab (*Lithodes maja*) and jonah crab (*Cancer borealis*). Overall the bycatch of stone crab was 2.4 mt (13% of snow crab catch), that of jonah crab about 340 kg.

Distribution of snow crab outside of commercial grounds from groundfish surveys

The groundfish surveys covered a much larger area than the commercial fishing, but the incidence of snow crab in the trawl catch was low (Fig. 13). Of a total of 5801 trawl sets between 1980 and 1994, 96 (1.7%) yielded snow crab. During each season most snow crab were collected on the eastern Scotian Shelf and in the Sydney Bight area. There were only 3 positive sets west of 62° longitude and no snow crab were captured during surveys of Georges Bank. Most snow crab were caught during the July surveys, but this was a reflection of greater sample size, and more sets on the eastern Scotian Shelf.

There are no records of commercial fishing 10-30 km north of Sable Island, but snow crab were frequently caught there during the July groundfish surveys. In fact the single biggest catch of snow crab (over 90 in July 1993) occurred just north of Sable Island. A survey directed at sealworm in flatfish provides more detailed information on this area (Tremblay, in press). Snow crab were a frequent component of the catch north of Sable Island, but not to the south. The carapace width of measured snow crab ranged from 37-92 mm, with a mean of about 60 mm (sexes combined).

DISCUSSION

1995 landings, catch rate and effort summed over Areas 20-24 were within a few percentage points of 1994, but this summation belies differences among the Areas. Below we discuss catch rate, effort, and levels of soft-shelled crab in the different Areas. We then discuss prospects for fisheries outside of the current commercial grounds.

Interpretation of changes in catch rate

Comparisons between CPUE in 1994 and 1995 are complex because of IBQs, changes in the practise of handling soft-shelled crab (Area 24 in particular), and differences in season length (i.e. Area 21 with a voluntary short season). The small number of fishers in Area 20 precludes any conclusions. For Area 21 catch rates were at least maintained in 1995, and may have been higher. Area 21 fishers returned substantial numbers of soft-shelled crab to the bottom in 1994 and these crab should have become available in 1995 as hard-shelled crab. In Area 22 there was no real limit on catch since the IBQ was not reached by any license. 1995 CPUE was either no different or lower than 1994.

Area 23 was the only Area with an IBQ in place in 1994 (29.5 mt in 1994, 24.9 mt in 1995). Catch rate was markedly higher in 1995. If the higher IBQ had been in place in 1995, fishing would have continued longer and mean catch rate presumably would have declined. However given that Area 23 regular licenses landed more crab in a shorter period of time in 1995, the available biomass must have been higher. This may be due to the soft-shelled crab that were returned to the bottom in 1994 becoming available in 1995.

In Area 24 catch rate changes from 1994 to 1995 differed by subarea. In the midshore of Area 24 many soft-shelled crab were landed in 1994, causing an inflated commercial catch rate relative to Areas that did not retain such crab. In 1995 less soft-shelled crab were landed and available biomass was presumably lower; the lower midshore catch rate in 1995 supports this interpretation. In the inshore portion of Area 24, fewer soft-shelled crab were landed, and available biomass in 1995 presumably increased.

Effort

Estimated total effort (number of trap hauls) for Areas 20-24 in 1995 suggests a slight decrease over 1994 but given the potential errors in the estimate, this may not be real. Even a stabilisation of total effort is surprising given the addition of temporary licenses in Areas 23 and 24, and the high price for snow crab. Unofficial figures indicate a price of about $7.70/kg which is higher than 1994 and just more than double the 1993 price. The lower than expected effort can be attributed to improved catch rates (particularly Area 23) together with the limits imposed by individual boat quotas (IBQs). IBQs restricted the effort of licenses in Areas 23 and 24, since their seasons were shorter than previously.

Total effort is still near all-time highs and will likely continue at this level with the current high price for snow crab. Total effort in Area 22 is the highest relative to the mean from 1978-93. Fishing at these high effort levels presumably results in higher removal rates and more soft-shelled crab in the trap catch. Soft-

shelled crab in the trap catch was high everywhere but there was no at-sea sample from the offshore portion of Area 22. The port sample from the offshore portion of Area 22 did however have the highest percentage of soft-shelled crab (Table 5). It would seem advisable to reduce effort in this Area in particular.

Soft-shell crab

There was a substantial reduction in the problem of landing soft-shelled crab in 1995. In 1994 the percentage of soft-shelled crab in the landed catch ranged from 6-26% (Tremblay and Eagles 1995). Anecdotal evidence indicated the percentage was even higher for the offshore portion of Area 24. In 1995 the range in port samples was 0-8%, with Area 24 in the range of 0-3%. It is not clear whether the improved situation was due to the specific measures adopted in the management plan, or whether other factors were responsible.

The high levels of soft-shelled crab in the traps (40-65%) continues to be a problem. In the southern Gulf the fishery is closed if 20% of the trap catch is soft-shelled. Although proper handling results in good survival of soft-shelled crab that are returned to the bottom, some mortality must result. There are no easy solutions to this problem. A switch to an earlier season may help alleviate it, but ultimately a substantial reduction in effort may be needed. On the positive side, the presence of large quantities of soft-shelled crab in the traps is a sign that recruitment is continuing---few soft-shelled crab were found in the traps during the mid 1980s when landings and catch rates were at all-time lows.

Outlook for Areas 20-24

In 1995 we recommended that total effort not increase, and that the landing of soft-shell crab be reduced. These modest objectives were met. We also noted that recruitment rates in Areas 20-24 appeared to be declining, and cited low recruitment trends in the Southern Gulf, Quebec and Newfoundland as supporting this interpretation. The 1995 fishery results are not indicative of a near-term recruitment failure. The high percentage of soft-shelled crab indicates recruitment is continuing. Although the relationship between the pre-recruit catch rate and future catch rates is not clear, many fishers remarked about the large numbers of small crab they saw in the traps this year.

Even with an improved index of pre-recruit abundance, other forecasting difficulties would remain. The future size and molt status of a group of SC crab cannot be reliably predicted because they can skip-molt, molt to large-claw (terminal molt), or molt to a larger SC crab. In the past Area 20-24 has had the added uncertainty of whether or not soft-shelled crab were retained (and thus harvested at least one year earlier than if they were returned to the bottom).

We can say that Areas 20-24 are currently fished at high effort levels relative to the 1978-93 period and have a higher percentage soft-shell than many Snow Crab Fishing Areas. Furthermore, unless there has been a fundamental shift in the productive capacity of eastern Cape Breton snow crab grounds, the high levels of landings are unlikely to continue.

Prospects for snow crab fisheries outside of the current commercial grounds

NAFO Division 4X -Mean catch rates of 1.5 kg/trap were less than 1/10th the mean CPUE in Areas 20-24. Snow crab on the Scotian Shelf are found mainly where summer bottom temperatures are less than 3 °C, and these conditions are limited to the eastern Scotian Shelf and cold pockets off southwest Nova Scotia (Tremblay, in press). While commercial catch rates on the western Scotian Shelf may improve with fishing skill, the snow crab aggregations west of Sable Island Bank are likely ephemeral. Recruitment likely originates from the eastern Scotian Shelf or southern Gulf of St. Lawrence. In spite of the low catch rates, these areas may support a small number of licenses with high trap limits during periods of good recruitment and high price. Effective measures against landing of soft-shelled crab will be important, and the success of these operations may be improved if they can land the bycatch of marketable species such as stone and jonah crab.

Offshore components of Areas 23 and 24 - Resource Allocation has received several proposals to fish snow crab (and possible other crab species) beyond 100 miles on the eastern Scotian Shelf. Although Area 23 fishers do not fish beyond 50-60 nautical miles on a regular basis, some have fished up to 90 nautical miles offshore, near the Gully (Tremblay et al. 1994, Fig. 13). Groundfish surveys indicate that the snow crab fishery is

exploiting (or has exploited in the past) most of the areas where snow crab are abundant on the eastern Scotian Shelf. Areas of light or no exploitation include (i) just north of Sable Island, (ii) a band of about 20 miles along the edge of the Laurentian Channel, and (iii) the eastern corner of Banquereau Bank. With the exception of the area just north of Sable Island, snow crab catches during groundfish surveys in these areas were infrequent (Fig. 13). Snow crab catches were even less frequent in 4X however, and the exploratory snow crab fishery there suggests some potential given certain conditions.

Given recent increases in effort by the regular fishery, caution is needed in creating any new fishing zones to allow more fishing operations. The Sable Island area should be considered last given that groundfish surveys indicate juvenile snow crab may be relatively more abundant there.

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Table 1. Landings for Areas 20-24 in 1994-95 and for all Areas combined, 1978-95.

Year	No. of active boats	No. of logbooks received	Landing Statistics Sales Slips (mt)	Landing Statistics logbooks (mt)	Actual (mt)	Mean CPUE (kg/trap haul) Standardized	Mean CPUE (kg/trap haul) All traps	Total Effort (1000's of trap hauls) Standardized	Total Effort (1000's of trap hauls) All traps
Area 20									
1994	5	4	29	24	29	20.9	20.2	1.4	1.4
1995	5	1	44	9	44	19.8	19.8	2.2	2.2
Area 21									
1994	31	29	107	100	108	6.7	7.2	16.0	14.9
1995	32	7	100	22	100	10.1	8.3	9.9	12.0
Area 22									
1994	38	28	259	196	259	13.2	12.0	19.6	21.6
1995	37	11	284	80	284	11.2	9.7	25.4	29.3
Area 23									
1994	22	22	497	497	497	34.7	33.4	14.3	14.9
1995									
Lic[2]	22	5	536	291	536	52.8	52.6	10.2	10.2
Temp[3]	9	2	40	9	40		34.9		1.1
Tot 95	31	7	576	301	576	52.8	51.8	10.9	11.1
Area 24									
1994									
Lic	14	14	429	446	446	30.3	30.3	14.7	14.7
Mid[4]	7	7	231	236	236	44.3	41.7	5.3	5.7
Tot 94	21	21	660	682	682	34.1	33.4	20.0	20.4
1995									
Lic	14	5	345	125	345	34.4	34.7	10.0	9.9
Mid	7	3	165	67	165	38.9	34.4	4.2	4.8
Temp	10	0	40	2	40		-		
Tot 95	31	8	550	194	550	35.7	34.4	15.4	16.0

Areas 20-24 Total

Year	No. of active boats	No. of logbooks received	Landing Statistics Sales slips (mt)	Landing Statistics logbooks (mt)	Actual (mt)	Total mean CPUE	Total Effort (1000's of trap hauls)
1978	42	42	801	748	801	28.4	28.2
1979	98	89	1,634	1,425	1,634	28.7	56.9
1980	99	81	819	652	819	19.8	41.4
1981	55	19	156	110	156	21.8	7.2
1982	67	56	554	503	554	16.7	33.2
1983	97	80	239	259	259	9.6	27.0
1984	51	38	124	105	124	8.6	14.4
1985	29	24	89	73	89	8.7	10.2
1986	29	23	120	115	120	10.2	11.8
1987	61	49	361	321	361	12.6	28.7
1988	88	74	596	552	596	14.6	40.8
1989	100	85	571	616	616	18.7	32.9
1990	102	87	1,144	1,152	1,152	25.4	45.4
1991	101	91	1,533	1,404	1,533	30.9	49.6
1992	104	77	1,797	1,354	1,797	32.5	55.3
1993	113	85	2,016	1,408	2,016	28.1	71.7
1994	117	83	1,551	1,443	1,574	21.2	74.2
1995	134	41	1,554	604	1,554	22.0	70.6
Mean					875	19.9	38.8

[2] Regular licenses

[3] 1-yr temporary permits

[4] Area 24 licenses restricted to midshore area

Table 2. Landings, catch rate and effort statistics for individual snow crab Areas 20-24, 1978-93.

Year	No. of active boats	No. of logbooks received	Landing Statistics: Sales Slips (mt)	Landing Statistics: logbooks (mt)	Actual (mt)	Mean CPUE (kg/trap haul): Standardized	Mean CPUE (kg/trap haul): All traps	Total Effort (1000's of trap hauls): Standardized	Total Effort (1000's of trap hauls): All traps
Area 20									
1978	-	0	61	0	61	-	-	-	-
1979	8	3	80	14	80	9.5	8.2	8.4	9.8
1980	8	3	34	11	34	11.4	8.3	3.0	4.1
1981	6	0	2	0	2	-	-	-	-
1982	-	0	2	0	2	-	-	-	-
1983	12	2	23	0	23	1.7	1.7	13.5	13.5
1984	2	0	10	0	10	-	-	-	-
1985	1	0	1	0	1	-	-	-	-
1986	2	1	0	0	0	1.9	1.9	0.0	0.0
1987	3	0	1	0	1	-	-	-	-
1988	4	2	17	8	17	7.0	7.9	2.4	2.2
1989	5	0	8	0	8	-	-	-	-
1990	4	2	5	2	5	5.4	5.3	0.9	0.9
1991	4	3	6	14	14	27.2	16.3	0.5	0.9
1992	3	3	7	18	18	78.3	40.6	0.2	0.4
1993	4	4	14	20	20	17.3	17.3	1.2	1.2
Mean					19[1]	17.7	11.9	3.8	4.1
Area 21									
1978	16	16	247	91	247	10.9	11.3	22.7	21.9
1979	27	27	243	193	243	10.6	10.7	22.9	22.7
1980	31	25	153	106	153	10.0	9.7	15.3	15.8
1981	22	1	34	1	34	13.6	13.6	2.5	2.5
1982	20	18	94	72	94	8.3	7.9	11.3	11.9
1983	27	25	48	35	48	5.5	5.1	8.7	9.4
1984	19	13	18	13	18	2.8	2.9	6.4	6.2
1985	10	7	6	10	10	3.5	3.5	2.9	2.9
1986	12	8	7	6	7	2.3	2.5	3.0	2.8
1987	21	15	56	54	56	8.1	6.4	6.9	8.8
1988	24	19	125	106	125	10.0	9.6	12.5	13.0
1989	30	27	154	133	154	25.8	13.7	6.0	11.2
1990	31	27	167	151	167	12.6	13.1	13.3	12.7
1991	29	27	157	151	157	18.7	14.9	8.4	10.5
1992	31	28	196	193	196	25.4	16.7	7.7	11.7
1993	30	28	168	151	168	16.7	14.2	10.1	11.8
Mean					117[1]	11.6	9.7	10.0	11.0
Area 22 - Inshore									
1978	11	10	67	195	195	28.5	19.2	6.8	10.2
1979	18	18	97	139	139	42.3	20.1	3.3	6.9
1980	14	14	92	63	92	15.7	12.6	5.9	7.3
1981	11	3	50	7	50	21.3	12.5	2.3	4.0
1982	10	8	31	24	31	13.8	8.1	2.2	3.8
1983	14	14	1	15	15	5.9	4.5	2.5	3.3
1984	3	3	0	3	3	4.1	3.5	0.7	0.9
1985	8	7	0	3	3	6.2	6.3	0.5	0.5
1986	4	3	3	11	11	6.0	6.0	1.8	1.8
1987	13	12	34	33	34	9.2	8.1	3.7	4.2
1988	21	16	54	69	69	9.6	8.0	7.2	8.6
1989	19	14	67	58	67	17.1	13.4	3.9	5.0
1990	20	16	67	59	67	11.9	9.8	5.6	6.8
1991	16	15	115	120	120	21.6	16.9	5.6	7.1
1992	19	12	125	92	125	19.1	19.1	6.5	6.5
1993	20	14	95	87	95	12.4	13.0	7.7	7.3
Mean					70[1]	15.3	11.3	4.1	5.3

Table 2 cont'd.

Year	No. of active boats	No. of logbooks received	Landing Statistics: Sales Slips (mt)	Landing Statistics: logbooks (mt)	Actual (mt)	Mean CPUE (kg/trap haul): Standardized	Mean CPUE (kg/trap haul): All traps	Total Effort (1000's of trap hauls): Standardized	Total Effort (1000's of trap hauls): All traps
Area 22 - Offshore									
1978	4	4	146	111	146	121.2	90.2	1.2	1.6
1979	17	17	545	449	545	50.1	50.1	10.9	10.9
1980	12	10	135	87	135	39.1	39.1	3.5	3.5
1981	-	-	-	-	-	-	-	-	-
1982	11	6	122	92	122	30.2	30.2	4.0	4.0
1983	12	7	37	26	37	13.4	13.4	2.8	2.8
1984	4	4	15	13	15	13.4	12.8	1.1	1.2
1985	0	0	0	0	0	-	-	-	-
1986	1	0	7	0	7	-	-	-	-
1987	3	2	29	21	29	16.4	16.4	1.8	1.8
1988	8	6	34	45	45	19.0	18.6	2.4	2.4
1989	7	6	24	26	26	20.3	21.0	1.3	1.2
1990	6	5	52	45	52	21.0	18.3	5.6	6.4
1991	8	8	47	63	63	23.6	22.5	2.7	2.8
1992	8	3	115	61	115	37.5	33.4	3.1	3.4
1993	20	13	295	181	295	25.1	26.1	11.8	11.3
Mean					109[1]	33.1	30.2	4.1	3.7
Area 23 - Inshore									
1978	15	15	276	347	347	62.3	51.5	5.6	6.7
1979	24	18	462	454	462	39.7	38.6	11.6	12.0
1980	24	14	289	266	289	39.4	36.0	7.3	8.0
1981	11	7	50	67	67	25.0	22.9	2.7	2.9
1982	19	13	175	183	183	31.4	26.7	5.8	6.9
1983	21	18	73	92	92	17.8	15.3	5.2	6.0
1984	10	5	21	30	30	14.5	15.7	2.1	1.9
1985	5	5	4	28	28	11.0	14.7	2.5	1.9
1986	6	6	21	49	49	11.5	14.4	4.3	3.4
1987	13	10	146	125	146	25.9	26.1	5.6	5.6
1988	17	15	159	136	159	20.4	22.1	7.8	7.2
1989	18	17	69	138	138	22.9	22.6	6.0	6.1
1990	12	12	105	176	176	29.9	28.7	5.9	6.1
1991	10	10	192	202	202	35.7	34.4	5.7	5.9
1992	9	7	226	170	226	44.5	40.4	5.1	5.6
1993	11	6	349	168	349	55.8	49.1	6.3	7.1
Mean					184[1]	30.5	28.7	5.6	5.8
Area 23 - Offshore									
1979	-	4	146	144	146	72.7	72.7	2.0	2.0
1980	-	7	54	50	54	69.0	69.0	0.8	0.8
1981	-	3	11	15	15	65.9	65.9	0.2	0.2
1982	-	10	67	70	70	36.2	36.2	1.9	1.9
1983	-	8	22	27	27	23.2	23.2	1.2	1.2
1984	-	2	8	11	11	33.7	33.7	0.3	0.3
1985	0	0	0	0	0	-	-	-	-
1986	0	0	0	0	0	-	-	-	-
1987	1	1	11	11	11	25.9	25.9	0.4	0.4
1988	4	3	48	27	48	44.0	44.0	1.1	1.1
1989	7	6	45	105	105	41.4	41.4	2.5	2.5
1990	15	12	203	210	210	46.8	46.8	4.5	4.5
1991	13	12	328	316	326	55.8	55.8	5.9	5.9
1992	13	11	369	327	369	57.0	57.0	6.4	6.4
1993	14	10	421	244	421	57.0	57.0	7.4	7.4
Mean					121	48.4	48.4	2.7	2.7

Table 2 cont'd.

Year	No. of active boats	No. of logbooks received	Landing Statistics: Sales Slips (mt)	Landing Statistics: logbooks (mt)	Landing Statistics: Actual (mt)	Mean CPUE (kg/trap haul): Standardized	Mean CPUE (kg/trap haul): All traps	Total Effort (1000's of trap hauls): Standardized	Total Effort (1000's of trap hauls): All traps
Area 24 - Inshore									
1978	-	0	4	0	4	-	-	-	-
1979	4	4	61	32	61	14.8	14.8	4.1	4.1
1980	10	10	62	70	70	12.8	12.8	5.5	5.5
1981	5	5	9	21	21	15.8	15.8	1.3	1.3
1982	7	7	56	62	62	10.1	10.1	6.1	6.1
1983	13	11	7	64	64	8.6	8.4	7.5	7.6
1984	13	12	52	47	52	9.2	9.2	5.6	5.6
1985	6	5	35	32	35	10.2	10.2	3.4	3.4
1986	7	5	46	49	49	11.9	11.9	4.1	4.1
1987	11	9	84	77	84	12.9	12.9	6.5	6.5
1988	12	12	105	120	120	13.4	13.4	9.0	8.9
1989	12	11	160	116	160	16.7	16.7	9.6	9.6
1990	11	10	292	259	292	27.3	27.3	10.7	10.7
1991	10	6	353	222	353	35.6	35.6	9.9	9.9
1992	11	6	430	251	430	38.6	38.6	11.1	11.1
1993	10	10	364	362	364	30.8	30.8	11.8	11.8
Mean					148[1]	17.9	17.9	7.1	7.1
Area 24 - Offshore									
1988	1	1	41	43	43	29.2	29.2	1.5	1.5
1989	2	2	12	20	20	16.2	16.2	1.2	1.2
1990	4	4	138	145	145	40.4	40.4	3.6	3.6
1991	4	3	119	106	119	40.8	40.8	2.9	2.9
1992	4	2	108	56	108	31.5	31.5	3.4	3.4
1993	4	2	136	74	136	46.1	46.1	3.0	3.0
Mean					95[1]	34.0	34.0	2.6	2.6
Area 24 Midshore Area									
1989	4	4	21	19	21	24.1	24.1	0.9	0.9
1990	4	4	108	105	106	54.5	54.5	2.0	2.0
1991	7	7	196	210	210	48.0	49.8	4.4	4.2
1992	7	6	205	186	205	43.0	43.0	4.8	4.8
1993	7	5	162	123	162	32.0	32.0	5.1	5.1
Mean					141	40.3	40.7	3.4	3.4

Table 3. Mean catch rate (kg/trap haul) and effort (n days fished) for fishers who provided effort information in both 1994 and 1995. Standard error is in brackets.

	Area 21	Area 22	Area 23	Area 24
N logs	6	9	12	8
1994 C/E	8.8 (0.75)	9.3 (1.37)	35.3 (3.19)	32.3 (5.33)
1995 C/E	9.0 (1.51)	9.4 (1.58)	60.6 (5.89)	35.8 (3.11)
1994 Effort	18.0 (1.10)	24.6 (1.80)	22.3 (1.96)	30.5 (2.58)
1995 Effort	14.0 (1.50)	25.9 (1.18)	13.8 (2.31)	21.5 (1.85)

Table 4. Average last fishing day by Area, 1993-1995. Same fishers were compared in 1993-94 and 1994-95. Mean date for 1994 differed at most +/- 1 day. Numbers of fishers for 1993-94 were 4 (Area 20), 22 (Area 21), 11 (Area 22), 8 (Area 23), and 12 (Area 24). For 1994-95, numbers of fishers were 4, 26, 22, 20 and 16.

Year	Area 20	Area 21	Area 22	Area 23	Area 24
1993	Aug 11	Aug 17	Aug 28	Sep 13	Sep 27
1994	Sep 2	Aug 15	Sep 5	Sep 13	Sep 29
1995	Aug 24	Aug 14	Sep 4	Aug 27	Sep 15

Table 5. Summary of commercial catch samples in 1995. Sample types are at-sea (S) and in-port (P). For at-sea samples, portion of sample ≥95 mm is shown for comparison with port samples. Sampling ports were Neil's Harbour (NH), Little River (LR), Glace Bay (GB), Louisbourg (LOU), L'Ardoise (L'ARD) and Canso (CAN).

Date	Area	Port	Grounds	Type	N males	Mean CW	% in shell stage: I	II	III	IV	(%) SC
July 25	21	NH	Inshore	S	385	104.9	38	25	37	0	21
				S ≥95	294	111.0	37	20	43	0	15
July 25	21	NH	Inshore	P	320	116.0	0	1	99	0	1
July 24	22	LR	Inshore	P	286	112.5	0	1	99	0	1
Jul 27 - Aug 16	22	GB	Offshore	P	900	108.2	8	12	75	6	21
Aug 24	23	LOU	Inshore	S	520	97.4	55	8	22	15	12
				S ≥95	277	108.5	65	5	24	7	12
Jul 26, Aug 17	23	LOU	Inshore	P	679	113.7	0	0	98	1	2
Aug 28	23	LOU	Offshore	S	406	109.2	41	7	39	13	2
				S ≥95	325	115.2	46	5	40	10	3
Sept 12	23	LOU	Inshore	S	445	98.6	51	16	17	16	15
				S ≥95	243	108.1	63	12	17	8	14
Sept 15	23	LOU	Offshore	S	623	96.7	19	17	39	25	5
				S ≥95	349	108.5	26	15	42	18	4
Aug 30, Sep 9	24	L'ARD	Inshore	S	503	126.6	56	4	37	4	6
				S ≥95	491	127.6	56	4	38	2	6
Aug 8, 18	24	L'ARD	Inshore	P	534	124.9	0	0	99	1	2
Aug 3, 15	24	CAN	Offshore	S	788	107.1	48	17	32	4	7
				S ≥95	537	118.9	54	11	34	1	5
Aug 2, 15	24	CAN	Offshore	P	700	118.7	3	2	93	2	3
Sep 12	24	CAN	Offshore	P	253	120.2	0	11	87	2	

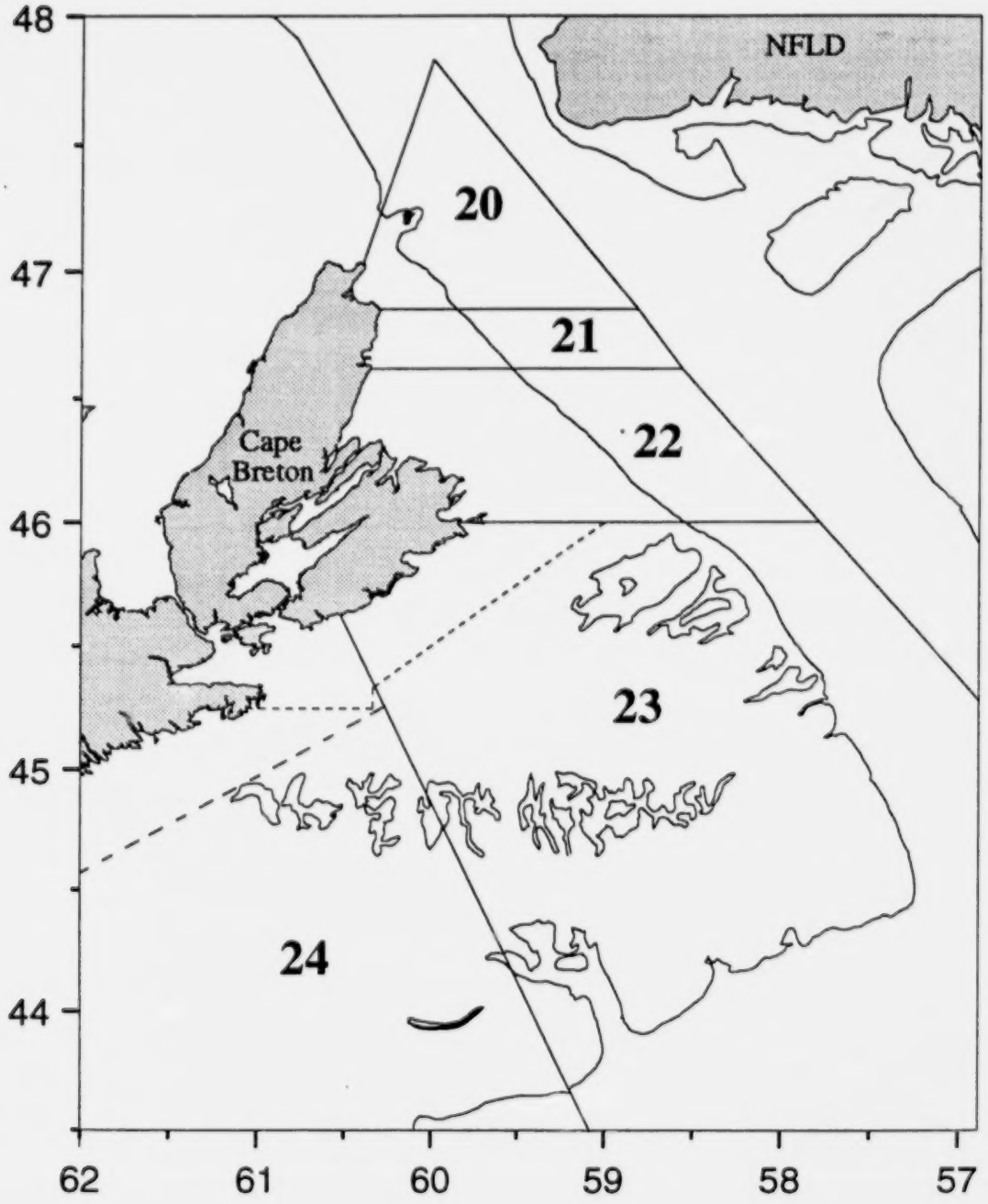

Figure 1. Snow crab Areas off eastern Cape Breton. Inner dashed lines are for assessment purposes only. The outer dashed line in Area 24 designates the midshore area to which 7 licenses are restricted.

Areas 20-22

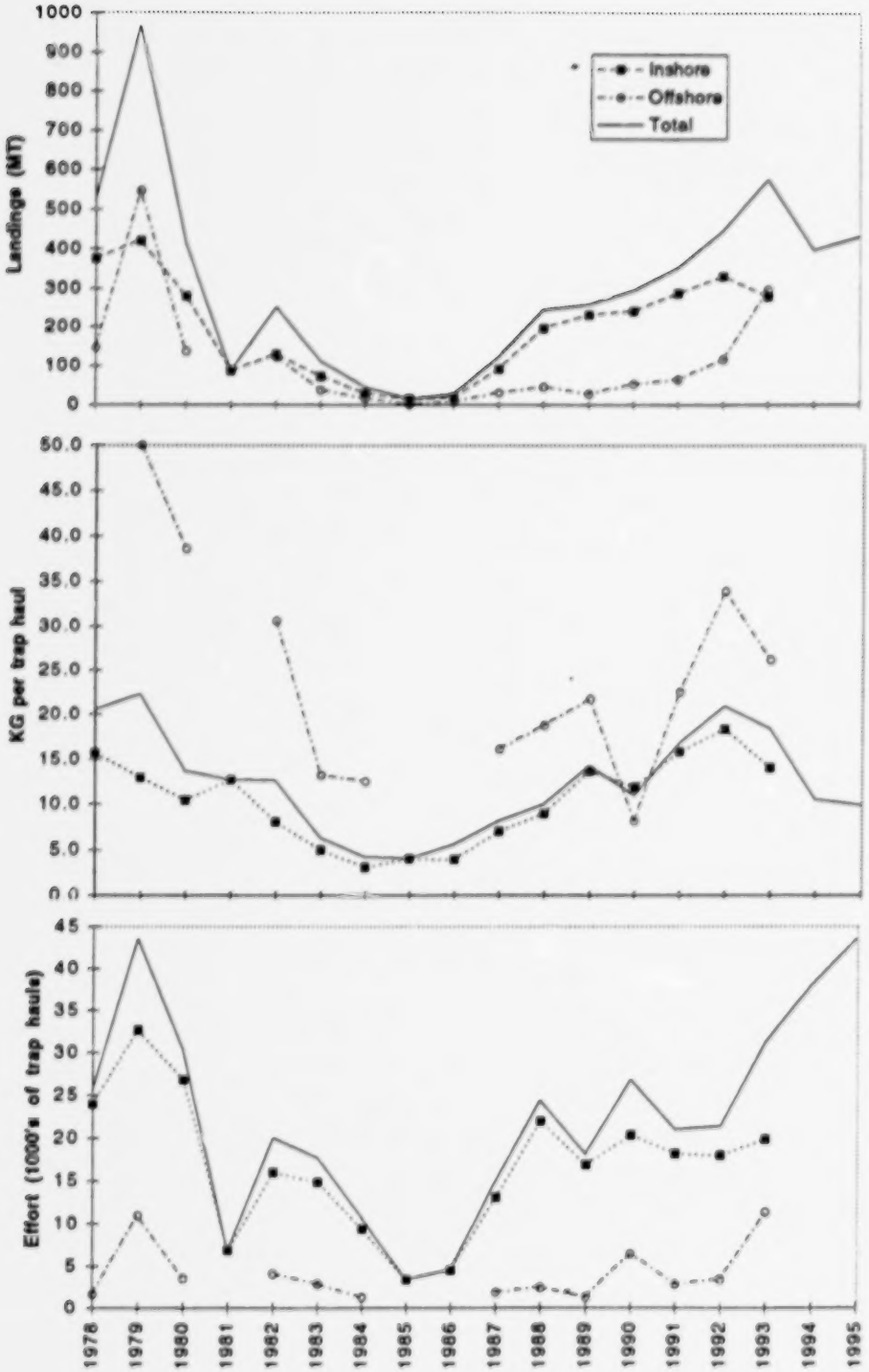

Figure 2. Historical landings, catch rate and effort in Areas 20-22.

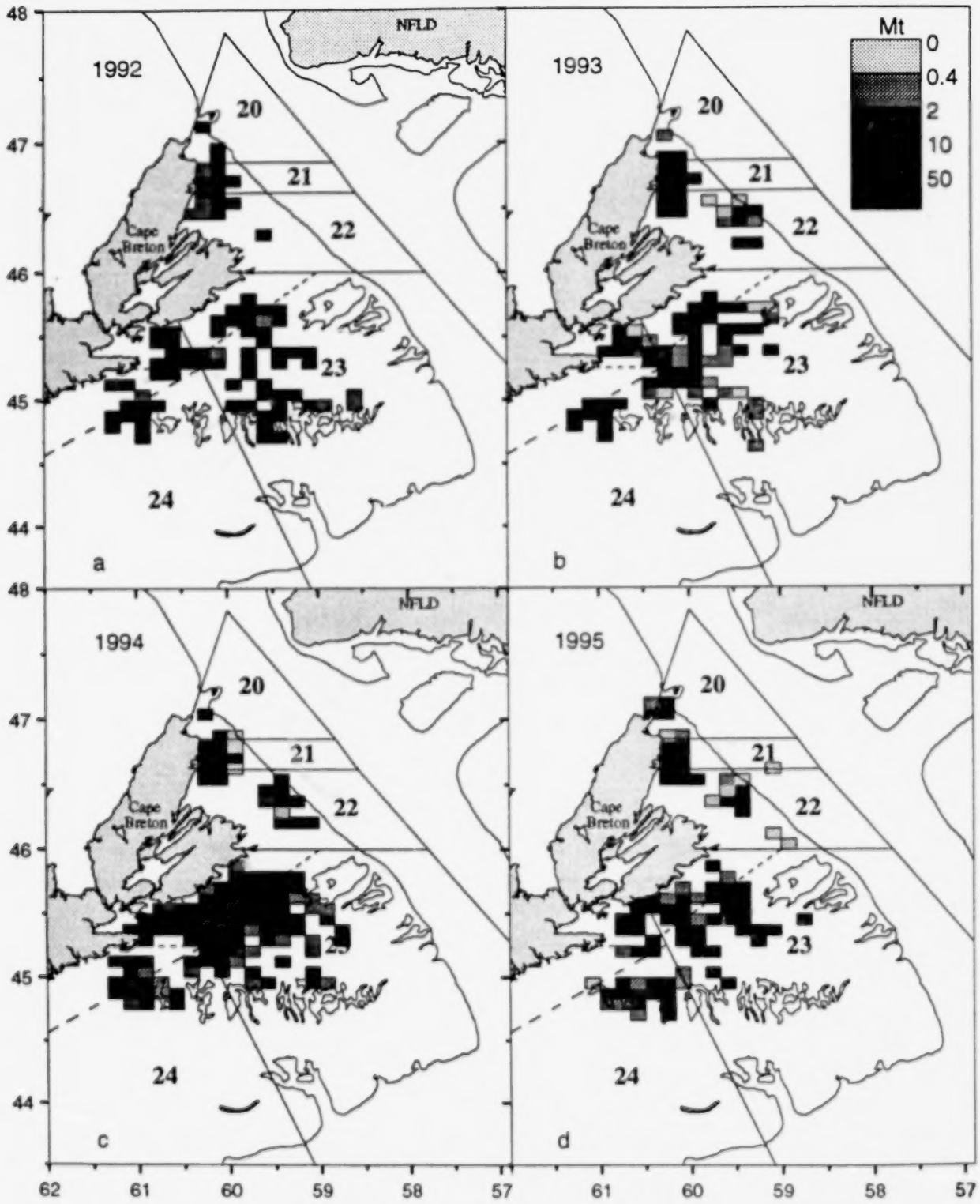

Figure 3. Areal distribution of snow crab catch in Areas 20-24 from 1992-1995. Map for 1995 based on fewer returned logs than in previous years (Table 1).

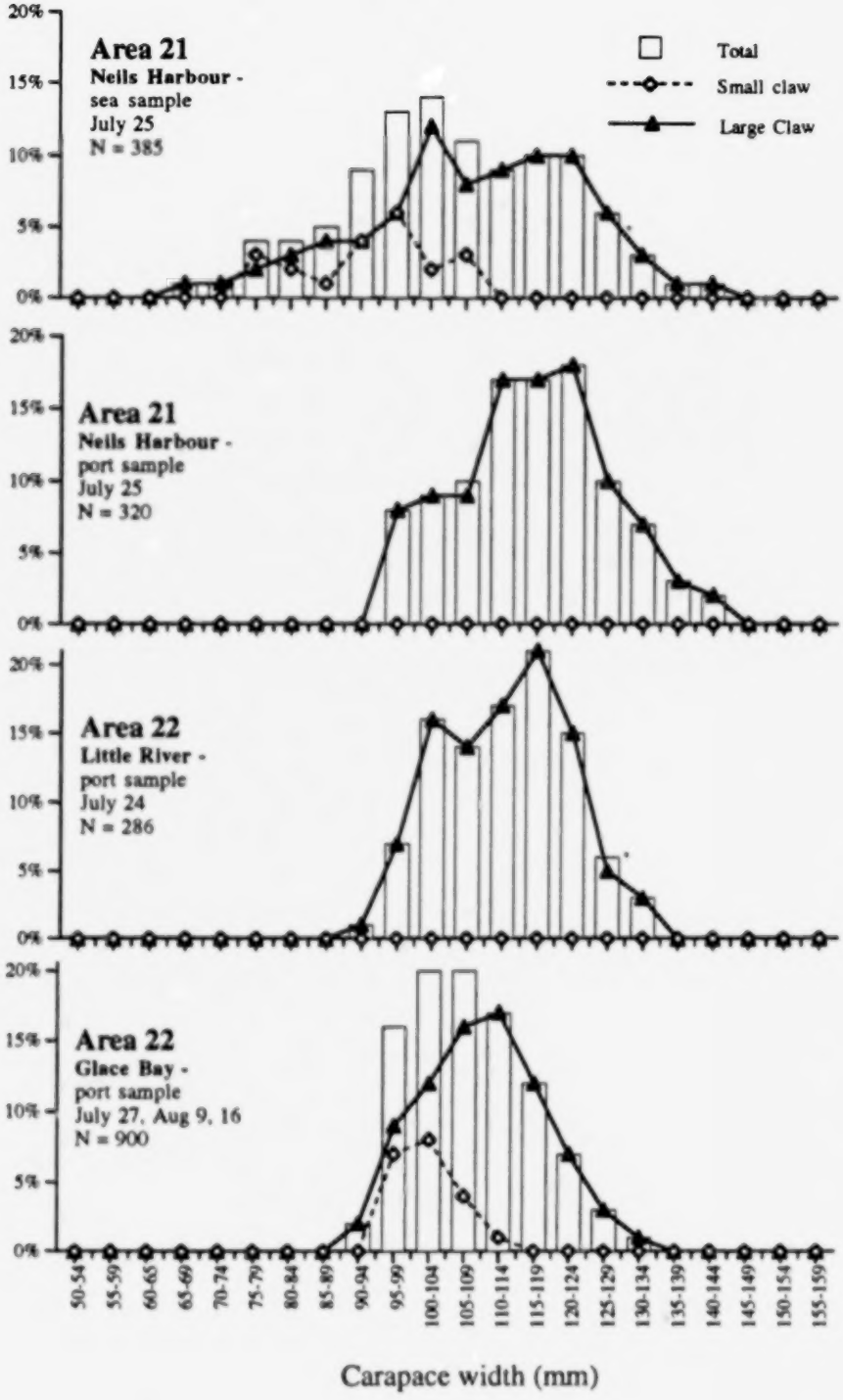

Figure 4. Width frequency of male snow crab from the commercial catch measured at sea and in port in Areas 21 and 22 in 1995.

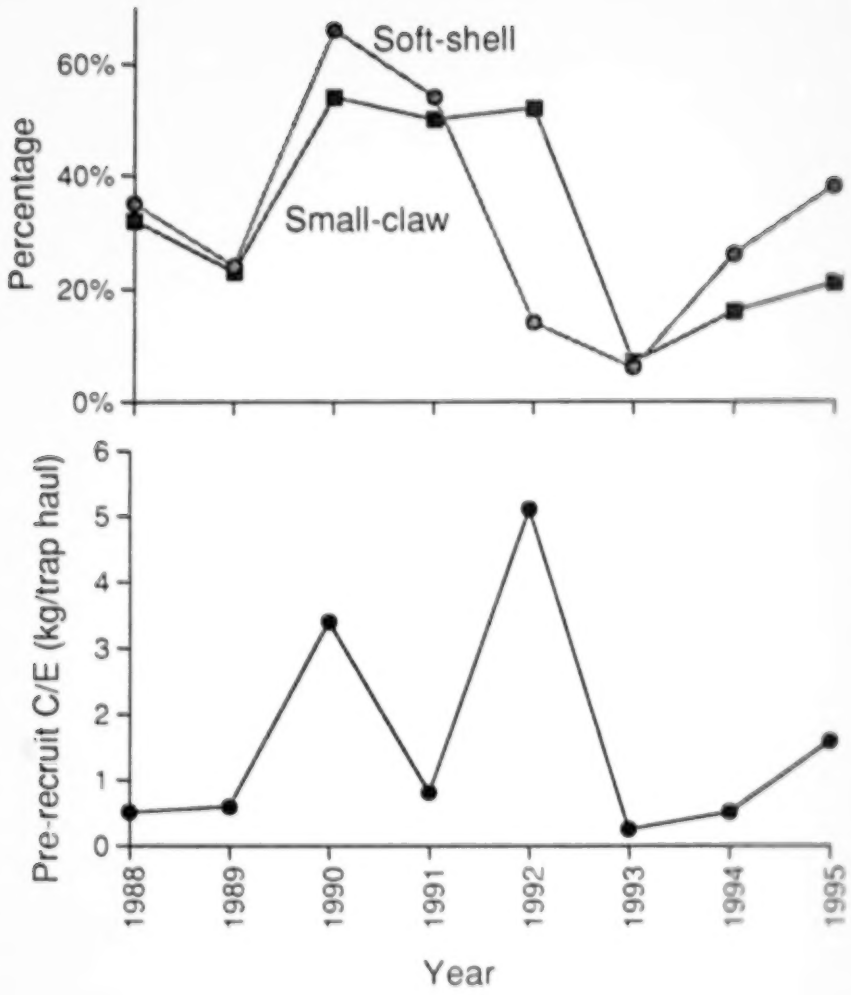

Figure 5. Sea sample indices for Area 21, 1988-95. Shown are the percentages of soft-shelled males, small-clawed males, and pre-recruit males (small-claw, 78-94 mm CW). All samples are from Neil's Harbour except 1988 (Ingonish).

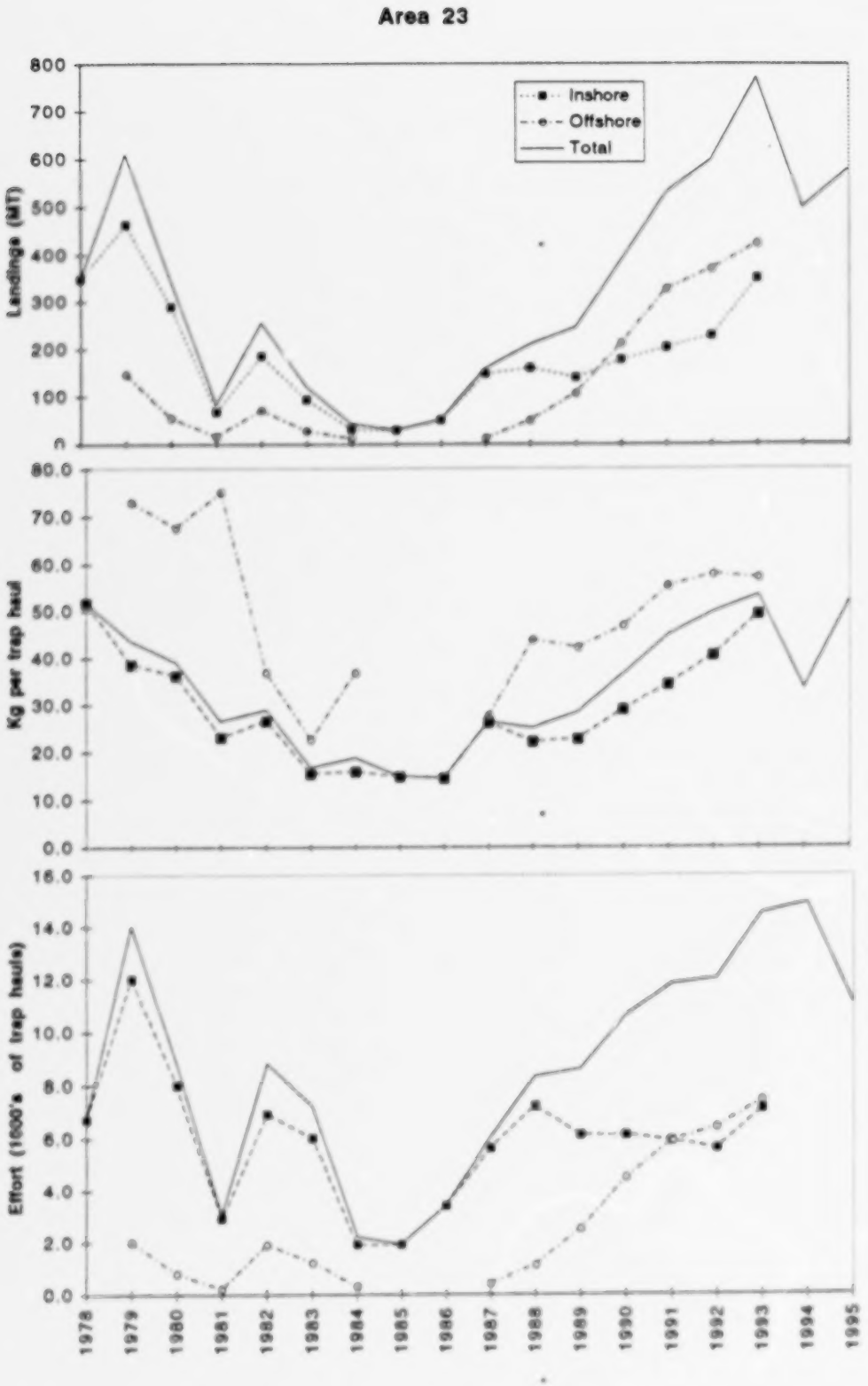

Figure 6. Historical landings, catch rate and effort in Area 23.

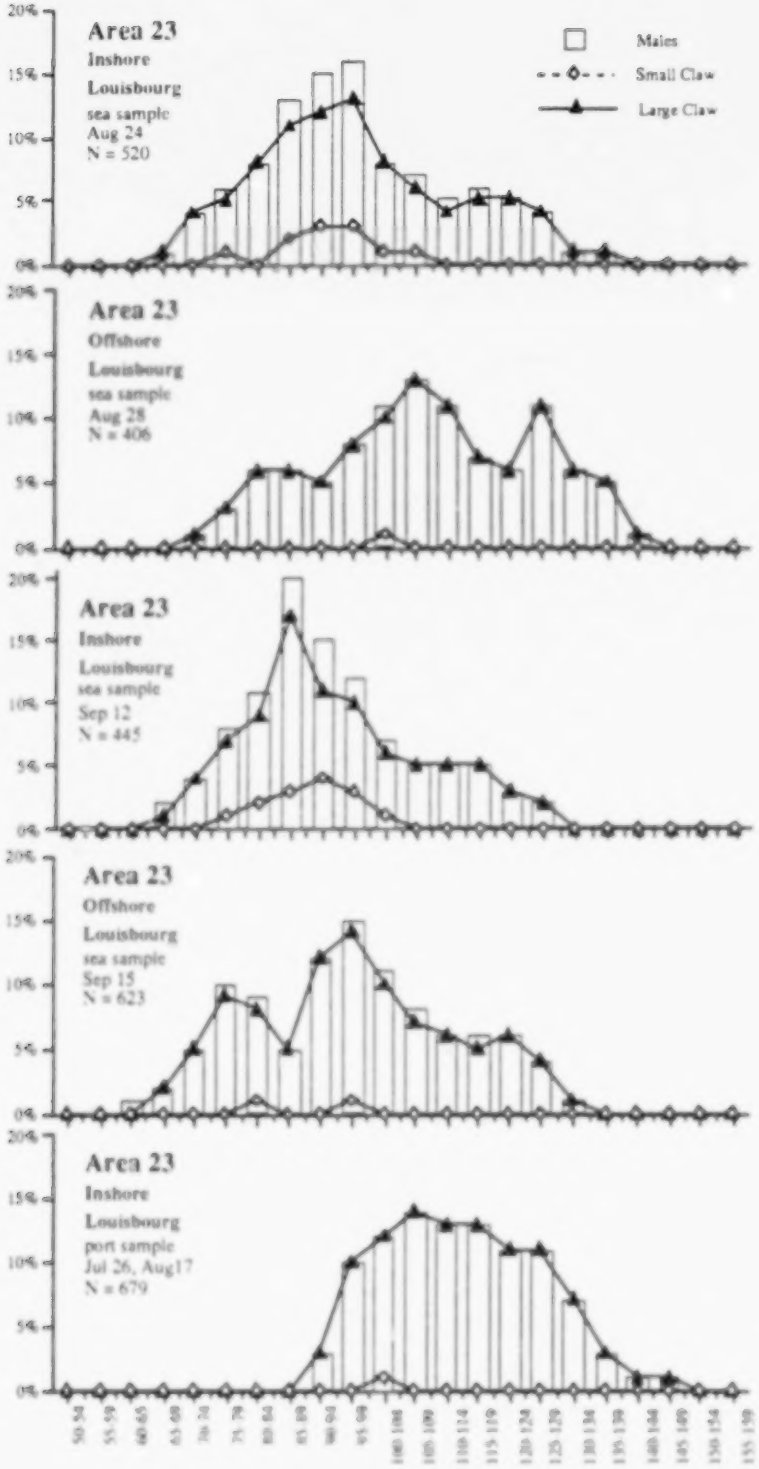

Figure 7. Width frequency of male snow crab from the commercial catch measured at sea and in port in Area 23 in 1995.

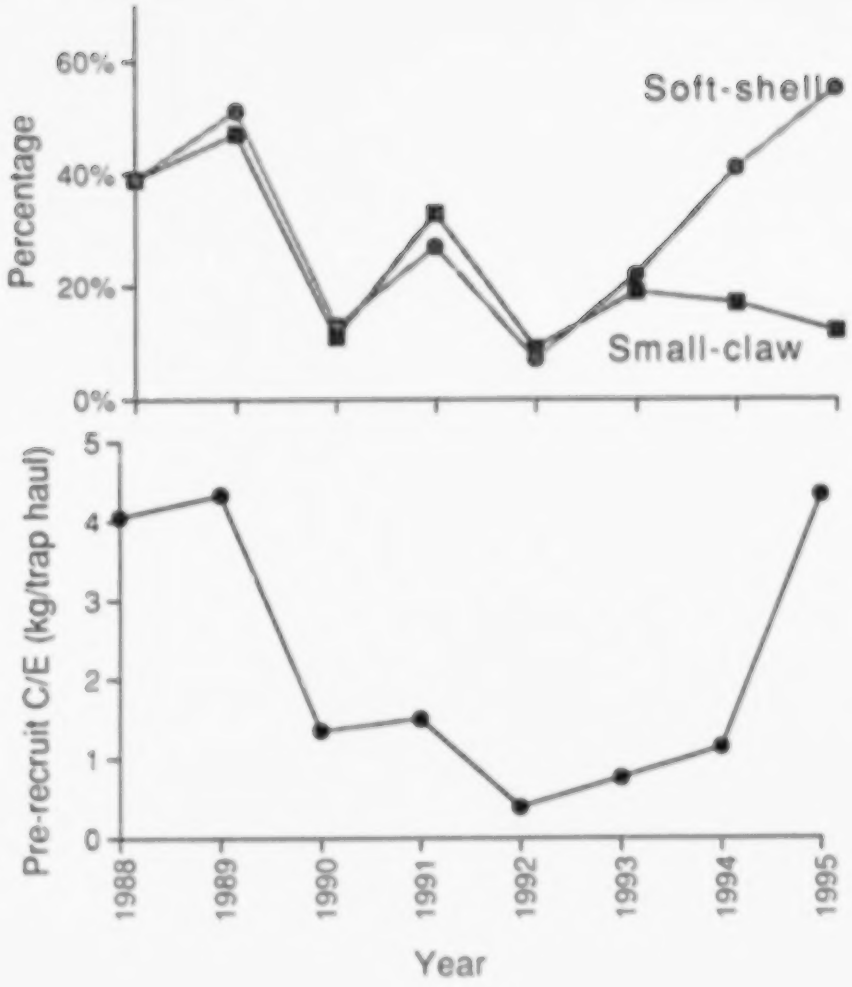

Figure 8. Sea sample indices for Area 23, 1986-95. Shown are the percentages of soft-shelled males, small-clawed males, and pre-recruit males (small-claw, 78-94 mm CW). All samples are from Louisbourg.

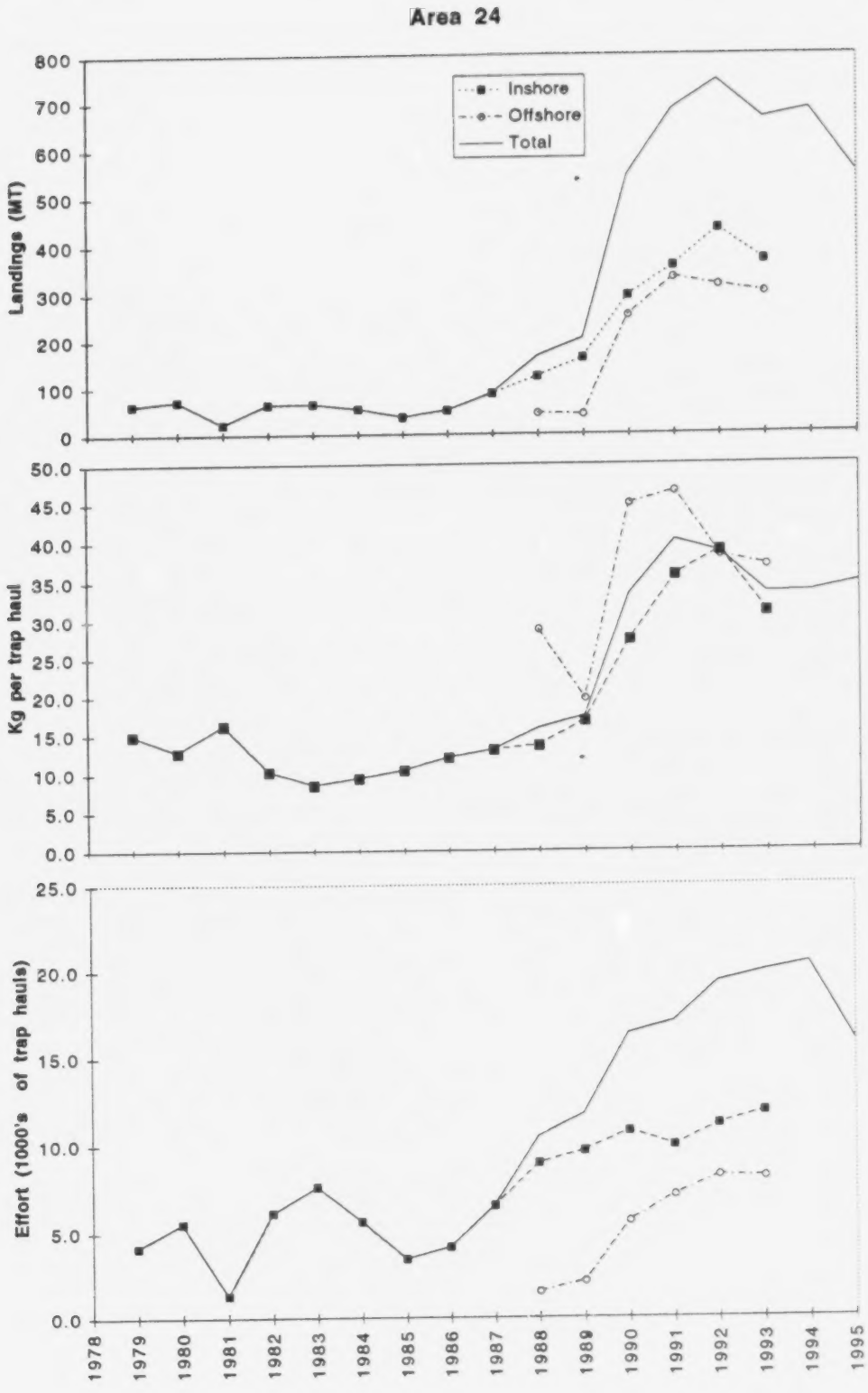

Figure 9. Historical landings, catch rate and effort in Area 24.

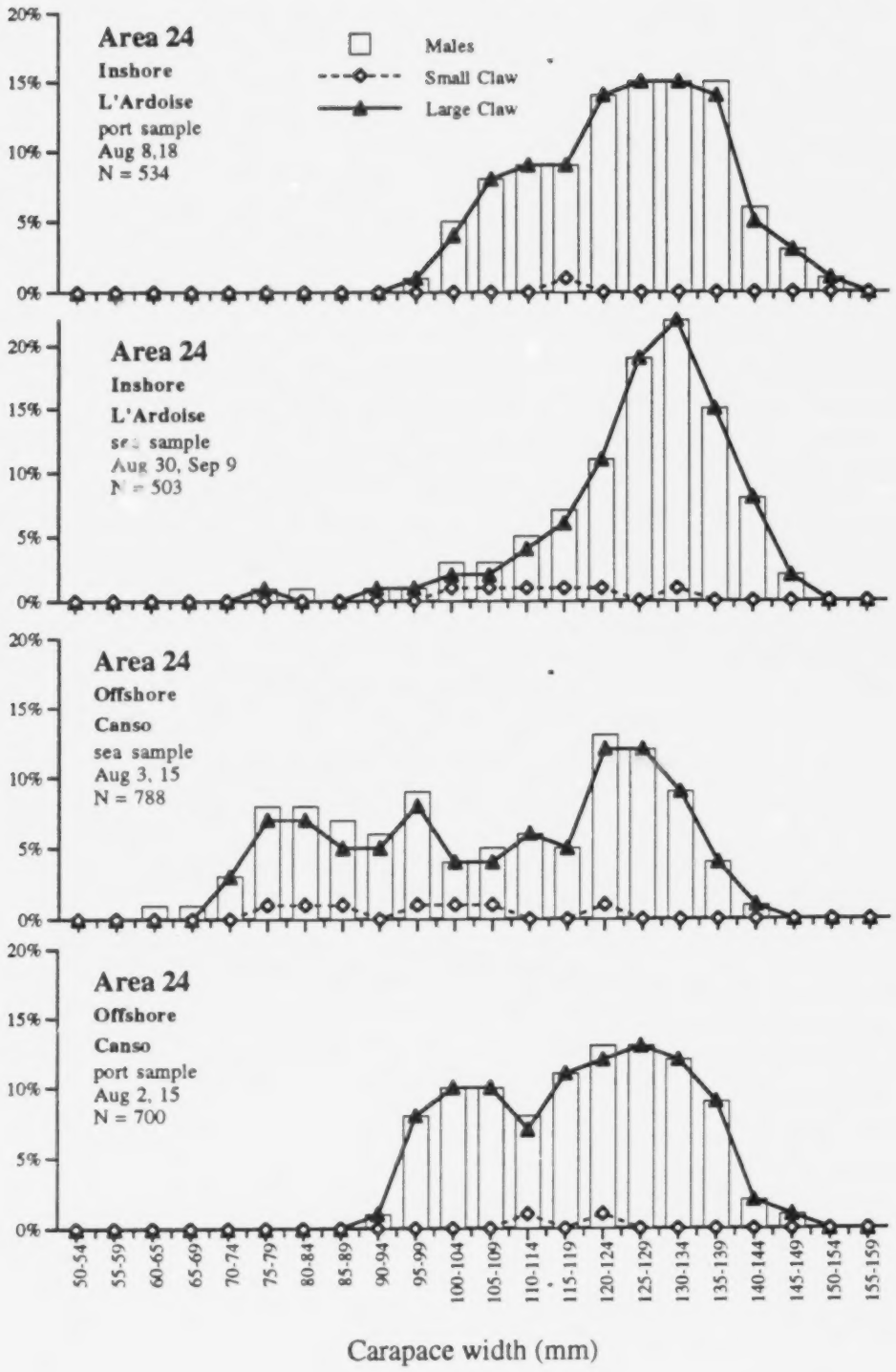

Figure 10. Width frequency of male snow crab from the commercial catch measured at sea and in port in Area 24 in 1995.

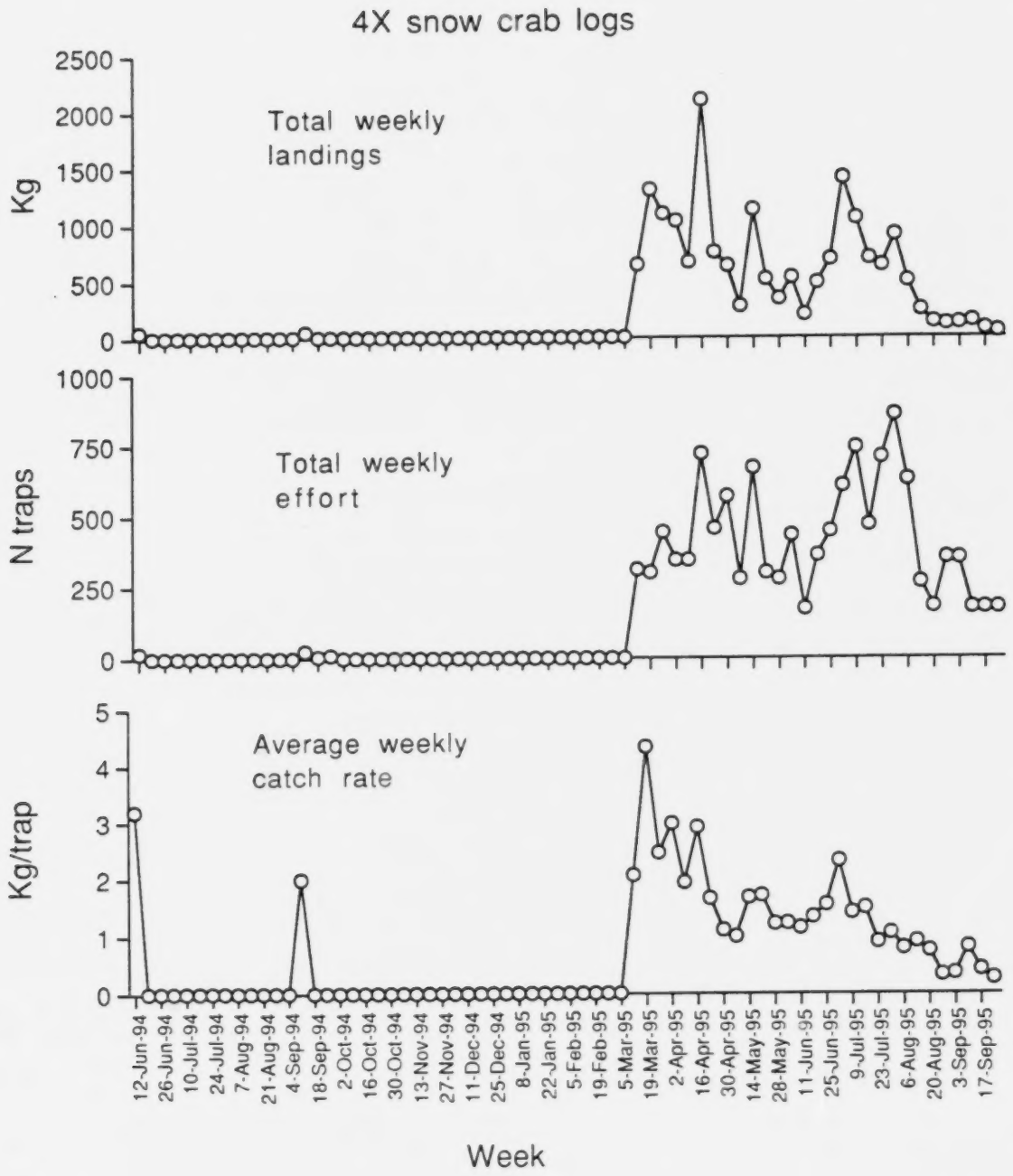

Figure 11. Landings, effort and catch rate of exploratory licenses in NAFO Division 4X. All data were aggregated by week.

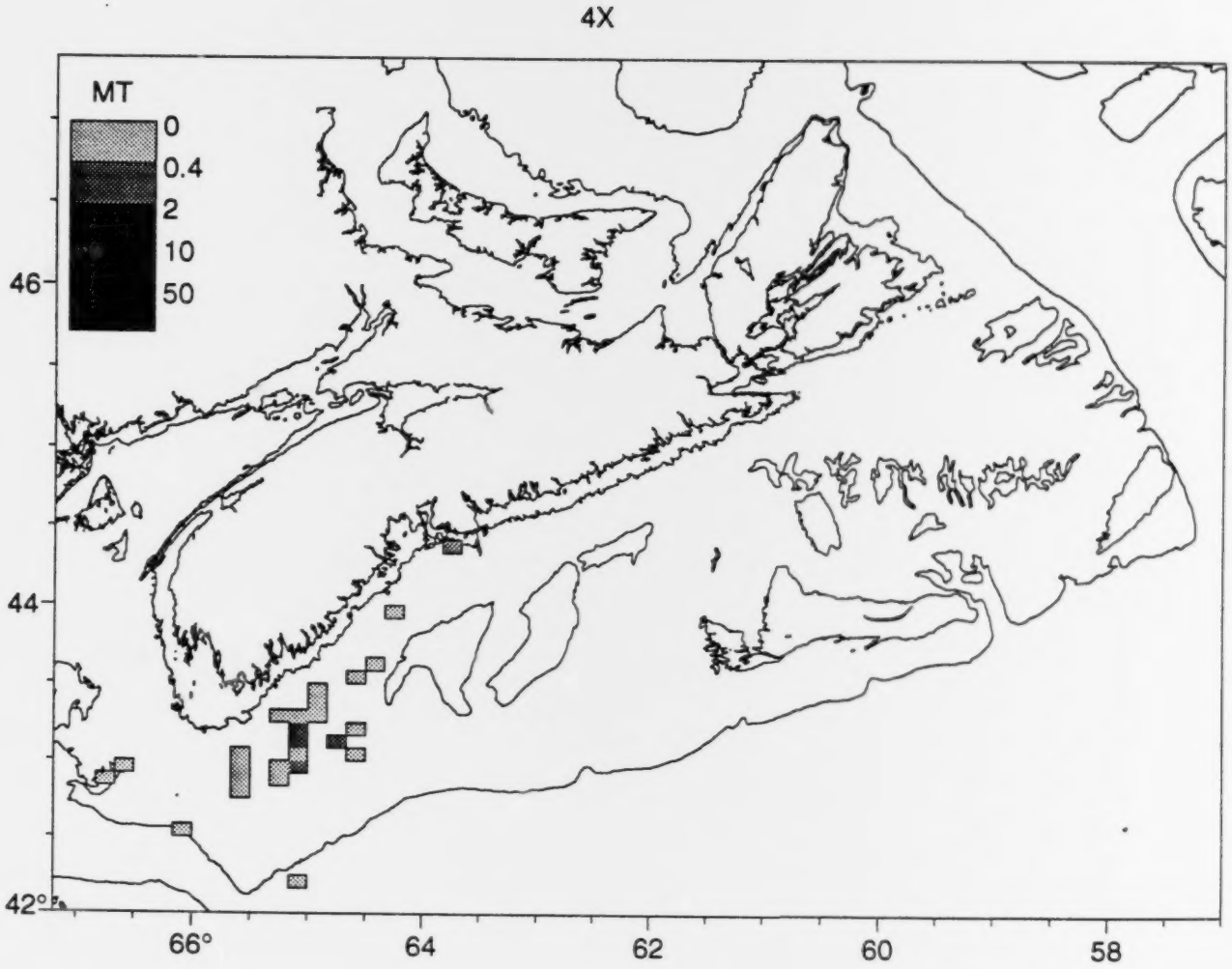

Figure 12. Distribuition of snow crab catch by exploratory fishers in NAFO Division 4X, 1994-95.

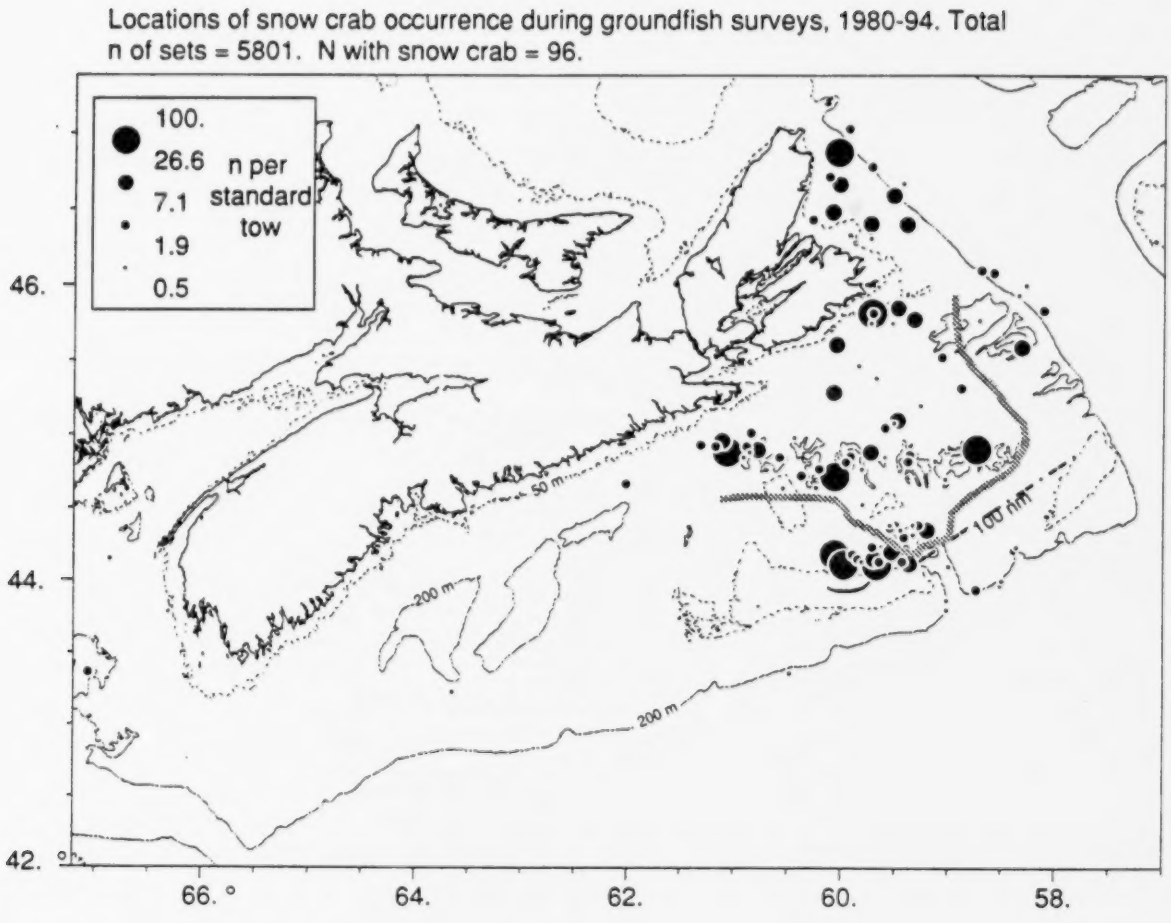

Figure 13. Occurrence of snow crab during groundfish surveys, with approximate limits of fishing by existing snow crab license-holders on the eatern Scotian Shelf (gray band). For reference purposes, a line 100 nautical miles from shore is shown.